DON BOSCO SCHOOL, BANDEL
ISC PRE-BOARD EXAMINATION (2025-2026)
MATHEMATICS
CLASS-12

(*Maximum Marks: 80*)
(*Time Allowed: Three hours*)

(*Candidates are allowed additional 15 minutes for **only** reading the paper.*
They must NOT start writing during this time.)

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*Candidates are required to attempt all questions from **Section A** and all questions **EITHER** from **Section B** **OR** **Section C***

*The Question Paper is divided into **three** sections and has **22 questions** in all.*

***Section A** is compulsory and has **fourteen** questions.*

*You are required to attempt **all** questions either from **Section B** or **Section C**.*

***Section B** and **Section C** have **four** questions each.*

*Internal choices have been provided in **two** questions of **2 marks, two** questions of **4 marks** and **two** questions of **6 marks** in **Section A.***

*Internal choices have been provided in **one** question of **2 marks** and **one** question of **4 marks** each in **Section B** and **Section C**.*

*While attempting **Multiple Choice Questions in Section A, B and C**, you are required to **write only ONE option** as the answer.*

All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [ ].

SECTION A (65 Marks)

Question 1 **[15 × 1 = 15]**

In sub-parts (i) to (xi) choose the correct option and in sub-parts (xii) to (xv), answer the questions as instructed.

i) If $\begin{bmatrix}1 & 3 & 7\\ 9 & 8 & 1\end{bmatrix} A = \begin{bmatrix}6 & 0 & 1 & 5 & 2\\ 2 & 1 & 5 & 6 & 7\end{bmatrix}$, then what is the order of the matrix A^T?

a) 2×5 b) 5×2 c) 3×5 d) 5×3

ii) The product of the order and the degree of the differential equation $y = x\frac{dy}{dx} + a\sqrt{1 + \left(\frac{dy}{dx}\right)^2}$ is

a) 2 b) 3 c) 4 d) 5

iii) If $y = x \tan y$, then $\frac{dy}{dx} =$

a) $\frac{\tan x}{x - x^2 - y^2}$ b) $\frac{y}{x - x^2 - y^2}$ c) $\frac{\tan y}{y - x}$ d) $\frac{\tan x}{x - y^2}$

iv) Let $A = \begin{bmatrix}1 & 0 & a\\ 2 & 3 & b\\ -3 & 1 & c\end{bmatrix}, B = \begin{bmatrix}1 & 0 & x\\ 2 & 3 & y\\ -3 & 1 & z\end{bmatrix}$ and $C = \begin{bmatrix}1 & 0 & a+x\\ 2 & 3 & b+y\\ -3 & 1 & c+z\end{bmatrix}$.

Assertion(A): det A+det B=det C.

Reason(R): A+B=C

a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.
c) Assertion is true and Reason is false.
d) Assertion is false and Reason is true.

v) A speaks truth in 75% cases and B in 80% of the cases. In what percentage of cases are they likely to contradict each other narrating the same incident?

a) 5% b) 15% c) 35% d) 45%

vi) Given a skew-symmetric matrix $A = \begin{bmatrix}0 & a & 1\\ -1 & b & 1\\ -1 & c & 0\end{bmatrix}$, then the value of $(a+b+c)^2$ is

a) 0 b) 1 c) 4 d) 9

P.T.O

vii) Which graph(s) shows the continuous function?

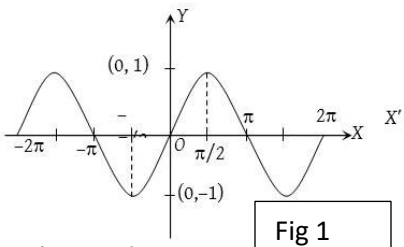


Fig 1

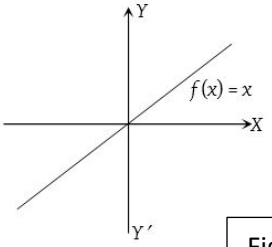


Fig 2

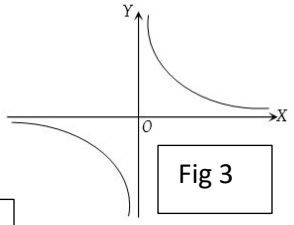


Fig 3

a) Fig 1 only
b) Fig 1 and 3 only
c) Fig 2 and 3 only
d) Fig 1 and 2 only

viii) If $y = f(x^2)$ and $f'(x) = e^{\sqrt{x}}$, then $\frac{dy}{dx} =$

a) $2xe^{2\sqrt{x}}$ b) $2xe^{x}$ c) $4xe^{\sqrt{x}}$ d) $4xe^{x}$

ix) **Statement 1:** Let $A = \{1, 2, 3\}$. Then the number of equivalence relation containing $(1, 2)$ is 2.
Statement 2: If A is the set of even numbers less than 8 and B is the set of prime number less than 7, then the number of relations from A to B is $2^9 - 1$.
Which one of the following is correct?
a) Statement 1 is true and Statement 2 is false.
b) Statement 2 is true and Statement 1 is false.
c) Both the statements are true.
d) Both the statements are false.

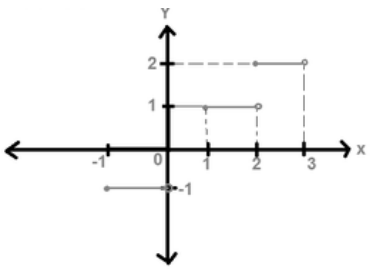
x) **Assertion(A):** Value of $sec^2(\tan^{-1} 3) + cosec^2(\cot^{-1} 4) = \frac{\pi}{2}$.
Reason(R): $\tan^{-1}\theta + \cot^{-1}\theta = \frac{\pi}{2}$.
a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.
c) Assertion is true and Reason is false.
d) Assertion is false and Reason is true.

xi) **Statement 1:** If $P(A) = \frac{7}{13}$, $P(B) = \frac{9}{13}$ and $P(A \cap B) = \frac{4}{13}$, then $P\left(\frac{A'}{B}\right) = \frac{4}{9}$.
Statement 2: If A and B are events such that $P\left(\frac{A}{B}\right) = P\left(\frac{B}{A}\right)$, then $A = B$.
Which one of the following is correct?
a) Statement 1 is true and Statement 2 is false.
b) Statement 2 is true and Statement 1 is false.
c) Both the statements are true.
d) Both the statements are false.

xii) Let the determinant of $A_{3\times3}$ matrix is 6 and B be a matrix given by $B = 5A^2$. Find $|B|$.

xiii) Let $A = \{1,2,3\}$. Then find the number of relations containing $(1,2)$ and $(1,3)$ which are reflexive and symmetric but not transitive.

xiv) At which points the function represented by the attached graph is not differentiable?



xv) Assume that in a family, each child is equally likely to be a boy or a girl. A family with three children is chosen at random. Find the probability that the eldest child is a girl given that the family has atleast one girl.

Question-2 **[2]**

i) Differentiate $sin^2 x$ with respect to $e^{\cos x}$.

OR

ii) Find the interval in which the function $f(x) = 2x^3 + 9x^2 + 12x - 1$ is decreasing.

Contd. Page 3

Question-3 **[2]**

Find the points on the curve $y = x^3 - 2x^2 - x$ at which the tangents are parallel to the line $y = 3x - 2$.

Question-4 **[2]**

Show that the general solution of the differential equation $\frac{dy}{dx} = e^{x-y} + x^2e^{-y}$ is $e^y = e^x + \frac{x^3}{3} + C$.

Question-5 **[2]**

i) Evaluate: $\int_1^4 (|x-1| + |x-2| + |x-4|)\, dx$.

OR

ii) Evaluate: $\int \frac{1}{1+\cot x}\, dx$.

Question-6 **[2]**

In the school project, Akash was asked to construct a triangle and name it ABC. Two angles A and B are given to be equal to $\tan^{-1}\frac{1}{2}$ and $\tan^{-1}\frac{1}{3}$ respectively. Then calculate the measurement of $\angle C$ in radian unit.

Question-7 **[4]**

Solve for x: $\sin^{-1}(1-x) - 2\sin^{-1}x = \frac{\pi}{2}$.

Question-8 **[4]**

i) If the equation of the family of curves is represented by $y = e^x(a\cos x + b\sin x)$ where a and b are arbitrary constants, then prove that they are also represented by $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = 0$.

OR

ii) If the equation of the family of curves is represented by $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ where a and b are arbitrary constants, then prove that they are also represented by $y\frac{dy}{dx} - xy\frac{d^2y}{dx^2} - x\left(\frac{dy}{dx}\right)^2 = 0$.

Question-9 **[4]**

i) Find the particular solution of the differential equation $2ye^{\frac{x}{y}}\, dx + \left(y - 2xe^{\frac{x}{y}}\right) dy = 0$, given that $y = 1$ when $x = 0$.

OR

ii) Find the particular solution of the differential equation $(\tan^{-1}y - x)dy = (1+y^2)dx$, given that $y = 0$ when $x = 1$.

Question-10 **[4]**

A shopkeeper sells three types of flower seeds A_1, A_2 and A_3. They are sold in the form of a mixture, where the proportion of these seeds are $4:4:2$ respectively. The germination rates of the three types of seeds are 45%, 60% and 35% respectively.

i) Calculate the probability that a randomly chosen seed will germinate.

ii) Calculate the probability that the seed is of type A_2, given that a randomly chosen seed germinates.

Question-11 **[6]**

Three friends went to a stationary shop in their locality and bought some items to gift their siblings/cousins in the occasion of Raksha Bandhan. Akash bought 5 pens, 3 bags and 1 geometry box and paid a sum of Rs.160. From the same shop, Vikram bought 2 pens, 1 bag and 3 geometry boxes and paid a sum of Rs.190. Also, Ankur bought 1 pen, 2 bags and 4 geometry boxes and pays a sum of Rs.250.

i) Represent the above information in a system of linear equation.

ii) Solve the system using matrix method.

iii) Find the cost of each article individually.

Question-12 **[6]**

i) Evaluate: $\int \frac{\sec x}{1+cosec\, x}\, dx$.

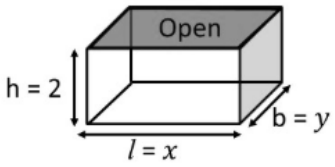
OR

ii) Evaluate: $\int_0^{\frac{\pi}{4}} \log(1+\tan x)\ dx$.

Question-13 **[6]**

i) A tank has rectangular base and rectangular sides, and is open at the top.

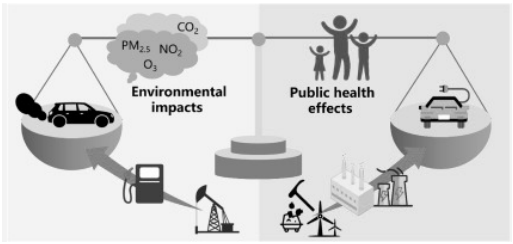
Such tank needs to be constructed so that its depth is 2 m and volume is 8 cubic metre. The cost of building the base of the tank is Rs.70 per square metre and the sides are Rs.45 per square metre.



a) Considering the length as x m and the breadth as y m, express y in terms of x.
b) Find the total cost function of constructing the tank.
c) Prove that the total cost is minimum when the length is equal to the depth of the tank.
d) Find the least cost of the construction of the tank.

OR

ii) The use of electric vehicles (EV) will curb air pollution in the long run. The use of EV is increasing every year and estimated EV in use at any time t is given by the function $V(t) = \frac{t^3}{5} - \frac{5t^2}{2} + 25t - 2$, where $t =$ 1,2,3, ... corresponds to year 2001, 2002, 2003, ….. respectively. Based on the given information answer the following questions:



a) Can the above function be used to estimate number of vehicles in the year 2000? Justify.
b) Prove that the function V(t) is an increasing function.

Question-14 **[6]**

Self-study helps students to build confidence in learning. It boosts the self-esteem of the learners. Recent surveys suggested that close to 50% learners were self-taught using internet resources and upskilled themselves.

A student may spend 1 hour to 6 hours in a day in upskilling self. The probability distribution of the number of hours spent by a student is given below:

$$P(X = x) = \begin{cases} kx^2, & for\ x = 1,2,3 \\ 2kx, & for\ x = 4,5,6 \\ 0, & otherwise \end{cases}$$

Where 'x' denotes the number of hours.

Answer the following questions:

a) Express the probability distribution given above in the form of a probability distribution table.
b) Find the value of 'k'.
c) Find the expected number of hours spent by the students.
d) What is the probability that the average self-study time of students is more than 2 hours?

Contd. Page 5

SECTION B (15 MARKS)

Question-15 **[1 × 5 = 5]**

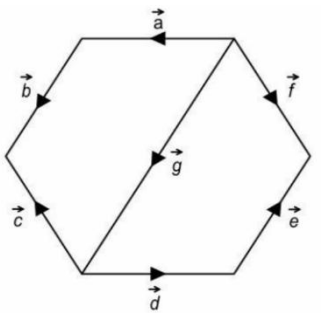
In sub-parts (i), (ii) and (iii) choose the correct option and in sub-parts (iv) and (v), answer the questions as instructed.

i) **Statement 1:** If θ is the angle between any two vectors $\vec{a}$ and $\vec{b}$, then $|\vec{a}.\vec{b}| = |\vec{a} \times \vec{b}|$ when θ is equal to $\frac{\pi}{4}$.

Statement 2: If $|\vec{a}| = 10, |\vec{b}| = 2$ and $\vec{a}.\vec{b} = 12$, then the value of $|\vec{a} \times \vec{b}|$ is 14.

Which one of the following is correct?

a) Statement 1 is true and Statement 2 is false.
b) Statement 2 is true and Statement 1 is false.
c) Both the statements are true.
d) Both the statements are false.



ii) Shown beside is a regular hexagon whose two vertices are joined by a vector. Which of these statement(s) is/are true?

I. $\vec{a}$ and $\vec{d}$ are equal vectors.
II. $\vec{b}$ and $\vec{e}$ are collinear vectors.
III. $\vec{c}, \vec{d}$ and $\vec{g}$ are coinitial vectors.

a) Only II
b) Only III
c) Only I and II
d) All three

iii) If the lines $\frac{x-2}{2k} = \frac{y-3}{3} = \frac{z+2}{-1}$ and $\frac{x-2}{8} = \frac{y-3}{6} = \frac{z+2}{-2}$ are parallel, then the value of 'k' is

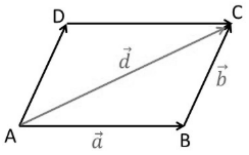
a) -2
b) $\frac{1}{2}$
c) 2
d) 4

iv) If $\vec{a}.\hat{\imath} = \vec{a}.(\hat{\imath} + \hat{\jmath}) = \vec{a}.(\hat{\imath} + \hat{\jmath} + \hat{k}) = 1$, then find $\vec{a}$.

v) If a line makes angles α, β and γ with the coordinate axes respectively, then find the value of $\cos 2\alpha + \cos 2\beta + \cos 2\gamma$.

Question-16 **[2]**

i) Find the area of the parallelogram in the given figure whose one side and a diagonal are represented by coinitial vectors $\vec{a} = \hat{\imath} - \hat{\jmath} + \hat{k}$ and $\vec{d} = 4\hat{\imath} + 5\hat{k}$.



OR

ii) The two vectors $\hat{\jmath} + \hat{k}$ and $3\hat{\imath} - \hat{\jmath} + 4\hat{k}$ represent the two sides $\overrightarrow{AB}$ and $\overrightarrow{AC}$ respectively of the triangle ABC. Find the length of the median through A.

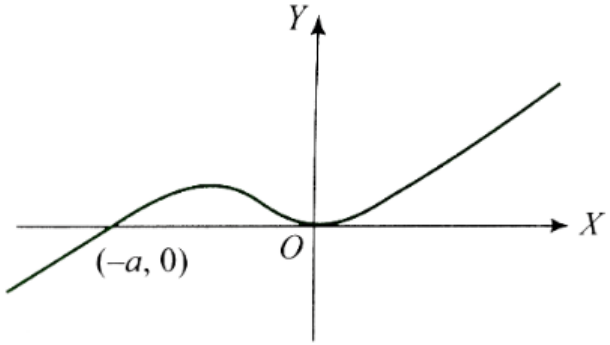
Question-17 **[4]**

i) Find the image P' of the point P having position vector $\hat{\imath} + 3\hat{\jmath} + 4\hat{k}$ in the plane $\vec{r}.(2\hat{\imath} - \hat{\jmath} + \hat{k}) + 3 = 0$. Hence find the length of PP'.

OR

ii) Find the coordinates of the point where the line through the points $A(3, 4, 1)$ and $B(5, 1, 6)$ crosses the xz-plane. Also find the angle which this line makes with xz-plane.

Question-18 **[4]**



Find the area included between the x-axis and the curve $a^2y = x^2(x + a)$.

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SECTION C (15 MARKS)

Question-19 **[1 × 5 = 5]**

In sub-parts (i) and (ii) choose the correct option and in sub-parts (iii) to (v), answer the questions as instructed.

i) Which condition is true if AC decreases with x and AC curve is falling?
   a) MC<AC
   b) MC=AC
   c) MC>AC
   d) MC ≤ AC

ii) **Statement 1:** The regression coefficients are independent of the choice of origin.
Statement 2: b_{yx} and b_{xy} are independent on the scales 'h' and 'k' applied to the variables.
Which one of the following is correct?
   a) Statement 1 is true and Statement 2 is false.
   b) Statement 2 is true and Statement 1 is false.
   c) Both the statements are true.
   d) Both the statements are false.

iii) Find the value of the covariance between x and y, if the regression coefficient of y on x is 3.75 and $\sigma_x = 2, \sigma_y = 8$.

iv) If the total cost function of producing x units of a commodity is given by $360 - 12x + 2x^2$, then calculate the level of output at which the total cost is minimum.

v) The corner points of the feasible region determined by the system of linear inequalities are $(0,0), (4,0), (2,4)$ and $(0,5)$. If the maximum value of $z = ax + by$, where $a, b > 0$ occurs at both $(2,4)$ and $(4,0)$, then find the relation between a and b.

Question-20 **[2]**

i) The demand per month for a commodity are 24 and 12, when the prices are Rs.16 and Rs.22 respectively. Assuming that the demand curve is linear, determine the demand function and the total revenue function.

OR

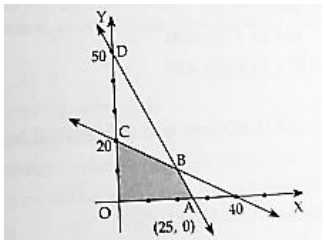
ii) A manufacturing company finds that the daily cost of producing x items of a product is given by $C(x) = 210x + 7000$. If each item is sold for Rs.350, find the minimum number that must be produced and sold daily to ensure no loss.

Question-21 **[4]**

The line of regression of marks in Maths (X) and marks in English (Y) for a class of 50 students is $3y - 5x + 180 = 0$. The average score in English is 44 and variance of marks in Maths is $\frac{9}{16}^{th}$ of the variance of marks in English. Find the average score in Maths. Also find the coefficient of correlation between marks in Maths and English.

Question-22 **[4]**

i) The feasible region for an L.P.P is shown in the figure. Based on the given information, answer the following questions:



   a) Find the equation of the line AD.
   b) Find the equation of the line BC.
   c) Find the constraints of the L.P.P.
   d) Find the maximum value of the objective function $z = 3x + 4y$.

OR

ii) A factory manufactures tennis rackets and cricket bats. A tennis racket takes 1.5 hours of machine time and 3 hours of craftmanship in its making, while a cricket bat takes 3 hours of machine time and 1 hour of craftmanship. The factory has availability of not more than 42 hours of machine time and 24 hours of craftmanship. Profit on a racket and on a bat are Rs.20 and Rs.10 respectively.
   a) If x and y are the numbers of bats and rackets manufactured by the factory, then write the expression of total profit.
   b) Write the constraint that relates the number of craftmanship hours.
   c) Determine the maximum profit (in Rs.) earned by the factory by graphical method.
   d) How many bats and rackets respectively are to be manufactured to earn maximum profit?

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